

C-B/13

21. (Amended) A method of variable bit rate video coding of video data on the basis of a predetermined average bit rate wherein quantization step size is set such as to hold a constant coded image quality level over a plurality of groups of picture images and the quantization step size is adjusted from a bit balance of a generated bit count with respect to an average bit rate with reference to the quantization step size that has been set as above.

REMARKS

Applicant has filed the present Amendment in reply to the outstanding Official Action of May 21, 2002, Applicant submits that the Amendment is fully responsive to the Official Action for reasons set forth below in greater detail.

In the present Official Action, the Examiner rejected Claims 1-21 as allegedly anticipated by a prior art reference to Katata, *et al.* (U.S. patent application no. 5,631,644) (hereinafter "Katata").

At the outset and before addressing particular rejections raised in the Official Action, Applicant has amended independent Claims 1, 11 and 21 (as well as dependent Claims 10, 17 and 20) commensurately with the Preliminary Amendment dated January 18, 2000, to more clearly recite an inventive aspect of the present invention. More particularly, the amended apparatus (and method) for variable bit rate video coding, *inter alia*, comprise: a quantization step size setting means for setting a reference quantization step size for each first image unit, corresponding to an average bit rate, from the predetermined average bit rate, the quantization step size provided to the video coding means and also the generated bit count; and a quantization step size adjusting means for calculating the average bit rate from the generated bit count and for

adjusting the quantization step size provided from the quantization step size setting means for each second image unit from the generated bit count provided from the video coding means and also from a bit balance of the generated bit count with respect to the average bit rate. Support for the amendments is found in the specification on page 21, lines 8-17 and page 23, lines 3-11 with reference to Figure 1 and 3, respectively. Applicant respectfully submits that not new subject matter has been added by the amendments herein.

With respect to the amendments of the specification, Applicant has amended the specification commensurately with the amended claims. Additionally, amendments on pages 18 and 23, corrected improper references to component 105, which should properly refer to component 103 of Figure 1.

In traversing the rejection of independent Claims 1, 11 and 21 pursuant to 35 U.S.C. §102(b), Applicant respectfully submits that the primary reference to Katata does not disclose adjusting the quantization step size for each second image unit based on the bit balance of the generated code bit count with respect to the average code bit rate. Katata is similar to the present invention in that the generated code quantity (i.e., generated bit count) is adjusted by adjusting a quantizing step. However, to the contrary of the present invention, Katata performs the quantization step adjustment by setting a threshold with respect to buffer occupation quantity in case a buffer for provisionally accumulating generated codes ruptures (that is, in case an underflow or overflow of the buffer may take place). In stark contrast to Katata, the present invention performs the quantization step size adjustment based on the bit balance or difference (either excessive or insufficient) between the generated bit count and the average bit rate. Specifically with

respect to the underflow of the buffer, Katata inserts dummy data when the generated code quantity is insufficient, which may result in an underflow of the buffer. To the contrary of Katata, in the present invention, the quantization step size is reduced to generate more codes when the generated bit count is insufficient. For this reason, no dummy data is inserted, and no code is wasted in the present invention. Specifically with respect to the overflow of the buffer, Katata reduces desired code quantity per picture, when the generated code quantity is excessive, which may result in an overflow of the buffer. To the contrary of Katata, in the present invention, when the generated bit count is excessive, the quantizing step size is increased to suppress code generation. In sum, Katata inserts dummy data or reduces desired code quantity such that buffer occupation quantity is always in a buffer size range. To the contrary of Katata, the present invention controls the generated bit count by adjusting the quantization step based on the difference or bit balance of the generated bit count and the average bit rate. The difference may be either positive or negative, and the magnitude of the difference may or may not be limited. For the foregoing reasons, Applicant respectfully submits that Katata fails to anticipate the present invention as claimed.

In view of the foregoing, Applicant respectfully requests the Examiner to withdraw the rejection of independent Claim 1, 11 and 21 pursuant to 35 U.S.C. §102(b). Furthermore, Applicant respectfully requests the Examiner to withdraw the rejections of dependent Claims 2-10 and 2-20 pursuant to 35 U.S.C. §102(b), based on their respective dependencies from independent Claims 1 and 11, respectively.

Attached hereto is a marked-up version of changes made to the specification and claims by the present Amendment, which is captioned "VERSION"

WITH MARKINGS TO SHOW CHANGES MADE".

In view of the foregoing, Applicant believes that the above-identified application is in condition for allowance and henceforth respectfully solicits the allowance of the application. If the Examiner believes a telephone conference might expedite the allowance of this application, Applicant respectfully requests that the Examiner call the undersigned, Applicant's attorney, at the following telephone number: (516) 742-4343.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning on page 6, line 18 has been as amended as follows:

--In this example, however, the quantization step size is set to control the bit count per unit time to be constant independently of input images. Therefore, in a scene requiring many bits, the image quality is degraded, because the generated bits are [is] suppressed by a large quantization step size.--

The paragraph beginning on page 9, line 26 has been as amended as follows:

--According to the present invention, there is provided an apparatus for variable bit rate video coding of video data on the basis of a predetermined average bit rate comprising: a video coding means for coding input video with a predetermined quantization step size and providing coded data and a generated code bit count; a quantization step size setting means for setting a reference quantization step size for each first image unit [in correspondence to], corresponding to an [the] average bit rate, from the predetermined average bit rate, the quantization step size provided to the video coding means and also the generated code bit count; and a quantization step size adjusting means for calculating the average bit rate from the generated code bit count and for adjusting the quantization step size provided from the quantization step size setting means for each second image unit from the generated code bit count provided from the video coding

means and also from a bit balance of the generated code bit count with respect to the average bit rate.--

The paragraph beginning on page 12, line 23, has been amended as follows:

--The quantization step size adjusting means for adjusting the quantization step size for each second image unit preliminarily sets a threshold for quantization step size, when the bit balance of the generated bit count with respect to the average bit rate is not excessive, the reference quantization step size set for each first image unit is compared with the threshold for quantization step size, for providing the quantization step size without any adjustment when the reference quantization step size is not exceeding the threshold quantization step size, and adjusting the quantization step size according to the bit balance to the average bit rate and selectively providing the greater one of the adjusted quantization step size and the threshold for quantization step size, and when the bit balance of the generated bit count with respect to the average bit rate is excessive, the quantization step size is adjusted according to the bit balance to the average bit rate, the adjusted quantization step size being provided as the quantization step size for each second image unit.--

The paragraph beginning on page 13, line 14 has been amended as follows:

--According to the present invention, there is provided a method of variable bit rate video coding of video data on the basis of a predetermined average bit

rate comprising: a video coding step of coding input video with a predetermined quantization step size and providing coded data and a generated code bit count; a quantization step size setting step of setting a reference quantization step size for each first image unit [in correspondence to], corresponding to an [the] average bit rate, from the predetermined average bit rate, the quantization step size provided to the video coding step and also the generated code bit count provided therefrom; and a quantization step size adjusting [means for] step of calculating the average bit rate from the generated bit count and of adjusting the quantization step size provided from the quantization step size setting [means] step for each second image unit from the generated code bit count provided from the video coding step and also from [an excess or shortage of the] a bit balance of the generated bit count with respect to the average bit rate.--

The paragraph beginning on page 15, line 2 has been amended as follows:

--The quantization step size setting step of setting the reference quantization step size for each second image unit includes a step of computing a first quantization step size by adjusting the quantization step size for each second image unit from the generated code bit count provided from the video coding step and [the excess or shortage of] the bit balance of the generated bit count with respect to the average bit rate; and in the computing step, a maximum bit rate is set, a second quantization step size is computed, which is set in the case of fixed bit rate control on the basis of the maximum bit rate, from the [quantized width] quantization step size set in the quantization step size setting step and the generated code bit count provided from the video coding step, and the greater one of the first and second quantization step sizes is provided to the video coding

step.--

The paragraph beginning on page 16, line 12 has been amended as follows:

--In the quantization step size adjusting means of adjusting the quantization step size for each second image unit, a threshold quantization step size is preliminarily set, when the [access or shortage of] bit balance of the generated bit count with respect to the average bit [count] rate is not excessive, the reference quantization step size set for each first image unit is compared with the threshold quantization step size, for providing the quantization step size without any adjustment when the reference quantization step size is not exceeding the [excess or shortage of] bit balance to the average bit rate, and adjusting the quantization step size according to the [excess or shortage of the] bit balance of the generated bit count with respect to average bit [count] rate and selectively providing the greater one of the adjusted quantization step size and the threshold quantization step size, and when the [excess or shortage of the] bit balance of the generated bit count with respect to the average bit [count] rate is excessive, the quantization step size is adjusted according to the [excess or shortage of] bit balance to the average bit [count] rate, the adjusted quantizing with being provided as the quantizing with for each second image unit.--

The paragraph beginning on page 17, line 4, has been amended as follows:

--According to [other] another aspect of the present invention, there is provided a method of variable bit rate video coding of video data on the basis of a

predetermined average bit rate wherein quantization step size is set such as to hold a constant coded image quality level over a plurality of groups of picture images and the quantization step size is adjusted from [the excess or shortage of the actual generated code bit rate] a bit balance of a generated bit count with respect to [the] an average bit rate with reference to the quantization step size that has been set as above.--

The paragraph beginning on page 18, line 23, has been amended as follows:

-- Fig. 3 is a view for describing the [quantization step size] average bit rate adjusting means [105] 103 shown in Fig. 1;--

The paragraph beginning on page 23, line 3, has been amended as follows:

-- Fig. 3 is a view for describing the [quantization step size] average bit rate adjusting means [105] 103 shown in Fig. 1. Referring to the Figure, the [quantization step size] average bit rate adjusting means 103 includes an average bit rate virtual buffer occupancy calculator 301 and a quantization step size modifier 302. The virtual buffer occupancy calculator 301 calculates a virtual buffer occupancy from the generated bit count S_j provided for each GOP from the video coding means 101 and the average bit rate.--

IN THE CLAIMS:

Claims 1, 10, 11, 17, 20 and 21 have been amended as follows:

1. (Twice amended) An apparatus for variable bit rate video coding of video data on the basis of a predetermined average bit rate comprising:

a video coding means for coding input video with a predetermined quantization step size and providing coded data and a generated code bit count;

a quantization step size setting means for setting a reference quantization step size for each first image unit [in correspondence to], corresponding to an [the] average bit rate, from the predetermined average bit rate, the quantization step size provided to the video coding means and also the generated bit count; and

a quantization step size adjusting means for calculating the average bit rate from the generated bit count and for adjusting the quantization step size provided from the quantization step size setting means for each second image unit from the generated bit count provided from the video coding means and also from a bit balance of the generated bit count with respect to the to the average bit rate.

10. (Twice amended) The apparatus for variable bit rate video coding [video data] according to claim 1, wherein:

the quantization step size adjusting means for adjusting the quantization step size for each second image unit preliminarily sets a threshold for quantization step size,

when the [excess or shortage of] bit balance of the generated bit count with respect to the average bit rate is not excessive, the reference quantization step size set for each first image unit is compared with the threshold for quantization step size, for providing the quantization step size without any adjustment when the

reference quantization step size is not exceeding the threshold quantization step size, and
adjusting the quantization step size according to the [excess or shortage of]
bit balance to the average bit rate and selectively providing the greater one of the adjusted
quantization step size and the threshold for quantization step size, and

when the [excess or shortage of] bit balance of the generated bit count
with respect to the average bit rate is excessive, the quantization step size is adjusted
according to the bit balance to the average bit rate, the adjusted quantization step size
being provided as the quantization step size for each second image unit.

11. (Amended) A method of variable bit rate video coding of video data on
the basis of a predetermined average bit rate comprising:

a video coding step of coding input video with a predetermined
quantization step size and providing coded data and a generated code bit count;

a quantization step size setting step of setting a reference quantization step
size for each first image unit [in correspondence to], corresponding to an [the] average bit
rate, from the predetermined average bit rate, the quantization step size provided to the
video coding step and also the generated code bit count provided therefrom; and

a quantization step size adjusting [means for] step of calculating the
average bit rate from the generated bit count and of adjusting the quantization step size
provided from the quantization step size setting step for each second image unit from the
generated code bit count provided from the video coding step and also from [an excess or
shortage of the] a bit balance of the generated bit count with respect to the average bit
rate.

17. (Amended) The method of variable bit rate video coding [video data] according to claims 11, wherein:

the quantization step size setting step of setting the reference quantization step size for each second image unit includes a step of computing a first quantization step size by adjusting the quantization step size for each second image unit from the generated code bit count provided from the video coding step and [the excess or shortage of] the bit balance of the generated bit count with respect to the average bit rate; and

in the computing step, a maximum bit rate is set, a second quantization step size is computed, which is set in the case of fixed bit rate control on the basis of the maximum bit rate, from the [quantized width] quantization step size set in the quantization step size setting step and the generated code bit count provided from the video coding step, and the greater one of the first and second quantization step sizes is provided to the video coding step.

20. (Amended) The method of variable bit rate video coding [video coding] according to claims 11, wherein:

in the quantization step size adjusting means of adjusting the quantization step size for each second image unit, a threshold quantization step size is preliminarily set, when the [access or shortage of] bit balance of the generated bit count with respect to the average bit [count] rate is not excessive, the reference quantization step size set for each first image unit is compared with the threshold quantization step size, for providing the quantization step size without any adjustment when the

reference quantization step size is not exceeding the [excess or shortage of] bit balance to the average bit rate, and

adjusting the quantization step size according to the [excess or shortage of the] bit balance of the generated bit count with respect to average bit [count] rate and selectively providing the greater one of the adjusted quantization step size and the threshold quantization step size, and

when the [excess or shortage of the] bit balance of the generated bit count with respect to the average bit [count] rate is excessive, the quantization step size is adjusted according to the [excess or shortage of] bit balance to the average bit [count] rate, the adjusted quantizing with being provided as the quantizing with for each second image unit.

21. (Amended) A method of variable bit rate video coding of video data on the basis of a predetermined average bit rate wherein quantization step size is set such as to hold a constant coded image quality level over a plurality of groups of picture images and the quantization step size is adjusted from [the excess or shortage of the actual generated code bit rate] a bit balance of a generated bit count with respect to [the] an average bit rate with reference to the quantization step size that has been set as above.